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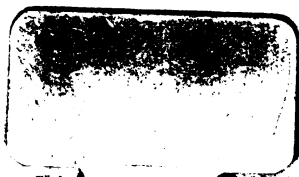
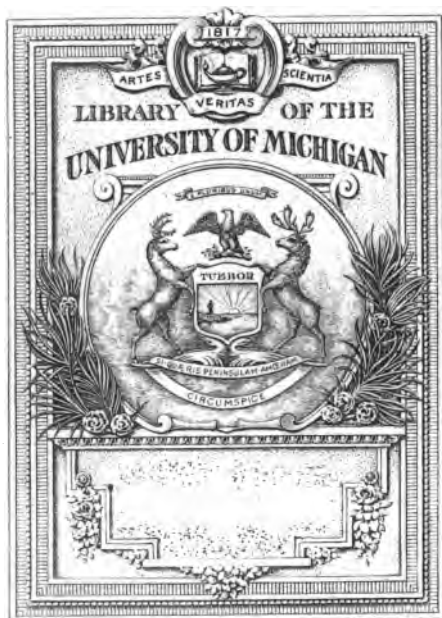
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# A NEBULO-METEORIC HYPOTHESIS

119174

## OF CREATION

—BY—

HERBERT W. PEARSON

REVISED AND EDITED

—BY—




WILLIAM F. PHELPS, M. A.

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 Q. J. Brown, D. D.

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### ACKNOWLEDGMENTS.

I desire hereby to express my grateful acknowledgments for the valuable assistance rendered in the preparation of this paper by Professor W. F. Phelps of the Duluth State Normal School, who has carefully edited and reduced to order the somewhat disconnected manuscript submitted to his inspection and revision.

H. W. PEARSON.

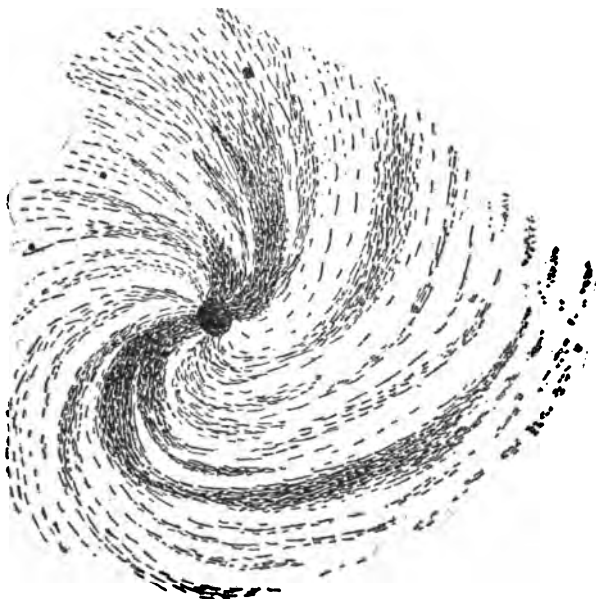


Figure 1.  
The Spiral Nebula (No. 99 Messier) from Nichols.  
Architecture of the Heavens.  
Sketches from Plate XVI.  
(Original drawing by Lord Rosse.)  
Retrograde motion shown.

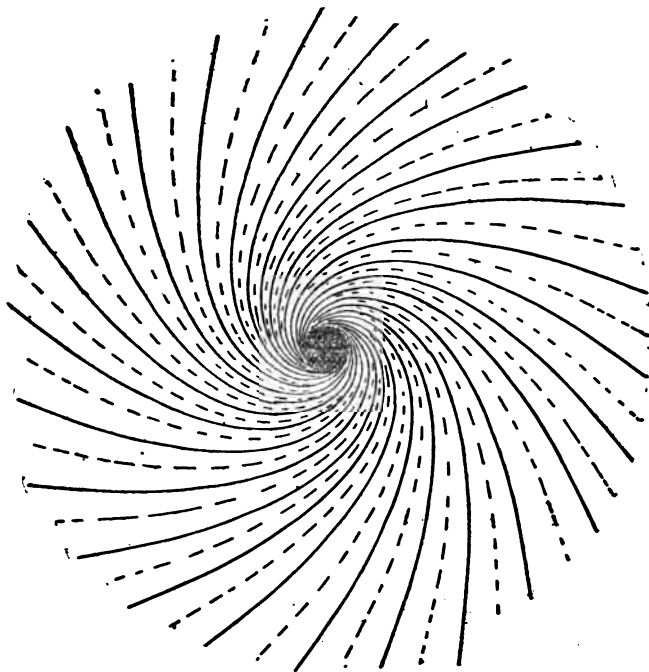


Figure 2.  
Diagram to show the paths of meteorites under the  
requirements of the Nebulo-Meteoritic Hypothesis.  
(The curve above indicated is very nearly that of a  
reciprocal or hyperbolic spiral.)  
Direct motion shown.

## INTRODUCTORY NOTES.

BY THE EDITOR.

A hypothesis may be defined as a tentative conjecture or guess, temporarily assigning a cause for known facts to be used as a basis for their classification and arrangement pending further observation, experiment or investigation.

A theory on the other hand, is a conclusively demonstrable proposition. The difference between a hypothesis and a theory consists largely, therefore, in the relative amount and quality of the support which each receives from the facts appertaining thereto.

The two terms are frequently, although not with strict accuracy, used synonymously and interchangeably, in order to avoid the too frequent repetition of either in the same connection. Hence, we speak of the nebular hypothesis sometimes as the nebular theory. But the Copernican theory is no longer regarded as hypothetical. A hypothesis may become a theory by additional investigation.

This explanation seems to be called for as a preliminary to the discussion that follows, both terms being frequently employed therein.

It may be further premised that every thoughtful person has an inherent right and should be encouraged to speculate upon natural phenomena, to ascertain so far as possible their nature and causes, to frame hypotheses and build up theories as to their

origin and purpose in the great scheme of the Universe. It is thus that the sum of human knowledge is increased and the progress of the race promoted and assured.

The modest author of the brochure which follows, takes issue with some of the conclusions of many of the most illustrious philosophers and writers both of past and present times upon the origin and the method of formation of our solar system. Starting with the postulate of Laplace as to the existence of a vast body of nebulous matter extending to the limits of our planetary system or beyond, our author argues that the process of world-building commenced with the condensation or, possibly the crystallization, of the nebulous matter upon the *surface*, rather than at the center of the mass then in a state of rotation, the resulting condensed bodies, or meteors, actuated by gravity, beginning at once to move to the center of the mass in obedience to the forces impelling them, and describing orbits somewhat spiral in form as shown in the diagram facing the title page. This assumption it will be seen by the reader, is a radical departure from the hypothesis of Laplace, and the consequences resulting therefrom are too numerous and important to admit of being specified here. The details will be found in the sequel, and a mere mention of some of them is all that can be attempted in this introductory note.

The origin and motions of comets and the laws that are conceived to control them, form perhaps the most remarkable feature of Mr. Pearson's paper. He has here ventured into a field hitherto unexplored. These eccentric, mysterious and unknown wanderers through the realms of limitless space



have really been disowned by the great theorists of the past, and are freely acknowledged by them to be "tramps, without home or country that have intruded themselves into our society unbidden". Our author however, ventures boldly into the trackless field, and presents new views of their nature with a series of what are designated "cometary laws" which cannot fail to challenge the attention of the Scientific World and lead to renewed investigation of these wonderful mysteries of the stellar depths. With the frankness and honesty of purpose characteristic of the true scientist, he advances in the form of terse propositions what he conceives to be the objections to his own unique views upon this abstruse subject.

A careful perusal of this interesting and valuable paper will disclose much additional new matter upon many topics, notably those which refer to the convergency of the orbital paths of meteors; the visibility of nebulae; the differential drift of the equatorial surfaces of the Sun and Jupiter; the distribution or diffusion of meteorites throughout infinite space, and other themes of the deepest interest, which cannot be more than mentioned in this connection.

If I mistake not the reader will be impressed with the luminous and yet perspicuous style of the author and his command of that ample fund of information which can come only from long, patient, methodical research in a field which comparatively few persons have either the capacity or courage to explore. It is to be hoped that the publication of these views will incite to further investigation. If such shall prove to be the result, the author will, I am sure, feel amply rewarded for his painstaking

labors, extending through many years, and in the face of many difficulties. A new path has thus been opened into the distant unknown, and new light has been shed upon some of the most perplexing mysteries of all the ages. Who will follow in his footsteps?

It is proper to add further that the author of this paper now entitled the new Nebulo-Meteoric Hypothesis was moved to its publication after its perusal by several of the leading scientific men of the country. The subjoined note to Mr. Pearson from Captain C. H. Davis, U. S. N., the veteran superintendent of the Naval Observatory at Washington, will be recognized as the opinion of one high in authority upon astronomical subjects.

WILLIAM F. PHELPS.

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U. S. Naval Observatory,  
Georgetown Heights,  
Washington, D. C., July 13, 1899.

Dear Sir:

I have read with interest your paper upon a "New Nebular Hypothesis." It seems to me to be a reasonable theory well supported by argument. I am particularly struck with your theory of the "Origin of Comets." I would advise you to publish your paper.

Very truly yours,  
C. H. DAVIS,  
Captain U. S. N.,  
Superintendent of Naval Observatory.

## NEBULO-METEORIC HYPOTHESIS OF CREATION.

Speculation as to the origin of the earth upon which we live seems to date back to the remotest ages.

Homer made River Ocean the parent of all things.

Hesiod derived the Earth from chaos, "a yawning abyss, composed of Void, Mass and Darkness, and from the bosom of the Earth came the sea, the mountains and the starry Heavens."

Anaxagoras thought the primitive condition of things, to have been a "heterogeneous commingling of substances" to which the operation of mind, communicated motion, and order.

The Egyptians found in Ra—the Persians in Ahura-Mazda creative power sufficient for the origin of the universe.

Theories of world building, other than those above named, have a place in history, the most important of which being the story of the creation as found in Genesis.

But as time passed, the inadequacy of these old hypotheses to explain newly discovered facts, man's unwillingness to accept theories which would construct something out of nothing, and the natural instinct of the human mind to probe yet deeper into the mysteries of the past,—all these reasons were the cause of the appearance of still other systems of world building.

### OTHER HYPOTHESES.

Kepler devised a scheme; Descartes originated his vortex theory—Leibnitz, Swedenborg, Wright

and Kant, each speculated on creation—Herschel did the same. But it was reserved for Laplace, who published his conception of the process of creation in 1796, to advance, or at least to more completely develop, that cosmological system which today—after the lapse of a century, still holds first place as the most acceptable of all doctrines by which we would attempt an explanation of the origin of the Universe.

Notwithstanding, however, this general acceptance, objections, numerous and weighty, have been urged against this hypothesis, and we are forced to admit that to many of these objections, the old theory has made and can make no reply. In fact, when those instances, wherein it utterly fails of explanation, are massed together, the array of phenomena that must seek solution from some source entirely extraneous to the scheme of Laplace, is truly formidable.

Professor Alexander Winchell in "World Life" (Griggs & Co., 1883) has collected an array of facts, thirty-five in number, which seem to corroborate the Laplace Hypothesis, and has compiled under various headings, an aggregate of seventeen different objections that have been raised at various times by various writers against that hypothesis. The principal points in Winchell's list of objections are the following:

1. The satellites of Uranus and Neptune have a motion contrary to that of all other satellites of our system.

2. The periodic times of the planets are longer than the Nebular theory allows.

(This objection is based on Kepler's Third Law.)

3. The periodic times of the planets are shorter than the Nebular Theory allows. For instance, Mercury has an orbital velocity 1800 times too great for the theory.

(This objection is based on the principle of Conservation of areas.)

4. The periodic time of the inner satellite of Mars is too short. The month of Phobos is only one-third of the day of Mars. The reverse condition should obtain.

5. The old theory does not explain the elliptic forms of the planetary orbits.

6. The masses of the asteroids are smaller than the theory demands.

7. The disrupted state of the asteroids is an anomaly in the operation of the theory.

8. The old theory offers no explanation of the genesis of comets. Laplace expressly states "In our hypothesis, the comets are strangers to the planetary system."

9. The spectra of the nebulae do not indicate sufficient pressure.

10. The theory does not explain the inclination of the planetary orbits to the sun's equator.

Of the other objections enumerated by Winchell, I make no mention. Some of them are of but minor importance; and others are based on uncertain data; but the following, not mentioned by him, should be added to the list:

11. The rigidity of the earth, as demonstrated mathematically by Lord Kelvin, Professor Darwin and others, is incompatible with the old theory, which seems to require a molten and fluid mass at the interior.

12. The differential drift of the surfaces of the Sun and Jupiter is antagonistic to the old theory, "A shrinking mass should rotate as a unit."

13. The present numerical value of the precession of the Equinoxes is incompatible with the old theory.

14. Were the sun a contracting fluid mass obtaining its heat from condensation, it should be hotter in the interior from increase of pressure, and breaks or cavities in the surface, like sun spots, should show brighter. On the contrary the bottom of sun spots show darker, and Henry, Secchi and Langley have shown them to be cooler. We must therefore decide the interior of the sun to be cooler than the exterior—in distinct opposition to the requirements of the old theory.

15. The old theory utterly fails to explain the singular fact that many of the nebulae are shown by the spectroscope to be gaseous, with an admixture of solid incandescent matter.

16. It fails to explain by known processes the interior density of the earth, which must much exceed at the centre the known density of  $2\frac{1}{2}$  at the surface.

17. It is generally believed that the older planets are those nearest the sun. If this condition is a fact, it disproves entirely the old hypothesis.

18. While the old hypothesis seems to explain with more or less reason the ringed and planetary forms of nebulae, it breaks down utterly in explanation of spiral forms.

19. It offers no explanation of the genesis of meteorites. These minute bodies, diffused through "all the realms of space" in countless millions, have a distribution so general—so universal—as to absolutely deny the idea of their introduction into our system from the depths of interstellar space, under any theory of capture.

20. The visibility of nebulae, it has been shown mathematically, cannot be due to incandescence of the infinitely attenuated gaseous mass. (Prof. T. J. J. See in the *Astronomical Journal*, Feb. 6, 1899.) A true cosmogony therefore, should be able to explain this visibility without assuming an original glowing incandescence.

#### ANOTHER HYPOTHESIS PROPOSED.

Some of the objections to Laplace's hypothesis above given, are perhaps of little weight. Others are of much importance. Their aggregate however (including many not mentioned) forms a combination so serious that many of our greatest scientists in the last decade, have abandoned this long accepted doctrine, and in preference thereto, have pronounced in favor of the meteoric growth of Sun and planets.

In view therefore of the fact that no cosmological scheme yet presented is generally acceptable and by reason of the great interest attaching to these questions, it must be admitted that there still remains opportunity for speculation in the matter.

Again, it will be acknowledged that when search is being made into the cause of the unexplained—when we attempt exploration into the depths of the unknown—we must invariably begin with some hypothesis—some hypothetical solution, to which we endeavor to fit the observed facts.

If logical application of this first hypothesis fails in the desired explanation, we then choose another guiding supposition and so continue until a reasonable solution appears for the phenomena under consideration. When success has thus been secured, we can then conclude that our original hypothesis has been advanced to the dignity of a theory.

Now with the object of justifying this discussion, we will assume that by reason of the many instances of insufficiency and inadequacy above cited, the theory of Kant and Laplace has broken down, and that it is our duty to study the origin of worlds by the introduction of new principles and different propositions.

With this prelude therefore we present the following method of treating the idea of meteoric growth in our solar system.

#### THE METEORITIC HYPOTHESIS OF CREATION.

We will assume in the beginning, as have all our predecessors in cosmological speculation, a great gaseous nebulous mass extending outwards into the depths of space, far beyond the orbit of Neptune. We will also assume that this mass has some slight movement of rotation, a progressive movement in space, that its temperature may be but slightly above the temperature of the interstellar void, and finally that there may be, outside of the main gaseous body, and unattached thereto, certain outlying wisps, patches, or streamers, of nebulous matter, similar to those attending the visible nebulae of our heavens.

If we are asked whence comes this gaseous mass, we do not reply. Dr. Croll would answer, "From the impact of two cold bodies meeting with

a velocity of 476 miles per second." But if we inquire whence came those two cold bodies, he would say "from two smaller nebulae," and so on *ad infinitum*. We will start, therefore, with our one gaseous mass. Further back into the abyss of time, the human intellect cannot go.

In all of these assumptions, we are safely within the realms of reason and analogy. We have but to point our telescope at the Heavens, and there we see represented a thousand times over our irregular, gaseous ideal.

We may make one other assumption. This mass must be in a condition of stable equilibrium, the expansive force of the slightly heated gas, joined to the tangential force due to rotation, being exactly counterbalanced by the force of gravity.

Thus far, we may follow the old theorists, but now our paths diverge. They supposed that this mass of fire mist would commence at once to precipitate itself toward the centre, under the action of gravity and refrigeration, until finally it became condensed at that point as a molten mass; certain planetary rings having been abandoned however, during this process of condensation, which likewise had resolved themselves into balls of molten material.

In our previous discussion however, we have seen that this assumption utterly fails in supplying an acceptable explanation. For the purpose of this argument therefore let us choose a proposition radically different. Let us assume that our primordial gaseous mass instead of slowly condensing into the fluid form as heretofore premised, may undergo at the surface a process of condensation or rather



crystallization into *the form of solid particles or meteorites.*

The cause of this crystallization we may conditionally attribute to the passage of heat from the nebula into outer space, or possibly to the passage of some material substance, some rare ether, in the same direction. We need not be too curious at present as to why or how such condensation to the solid form should take place but having assumed that crystallization might occur as suggested, let us make a study of the results that might be arrived at under the guidance of this new principle.

The solid and comparatively cool crystals formed as above suggested, at once commence a slow sinking through the gaseous fluid, towards the centre of the nebula. This sinking however would take place, not in right lines toward the centre, but all these particles would be deflected by the original rotational movement at the surface of the nebula. The paths of these bodies would therefore assume the nature of spirals, and these spiral paths or orbits would all meet at the centre of the nebula, where aggregation would necessarily occur, and the resulting nucleus would have a rotary movement proper to the total eastward motion of the individual meteors. —

In this suggestion, it can be seen, we may find an origin for the countless hosts of meteorites existing in interplanetary space, (400,000,000 of which strike the earth daily) and for the uniformity and universality of their distribution.

#### THEORIES OF ORIGIN.

This conception of the origin of meteorites through crystallization, I believe is due to Schiaparelli, who thinking these bodies to be "messengers

from the stellar void," suggested that they "may have been formed in space, by the local concentration of the celestial matter in a manner analogous to the crystallization of substances chemically dissolved in liquid.

(Lockyers Meteoritic Hypothesis, p. 251.)

Other origins for these minute planets have been suggested. Professor Kirkwood derived them from rings thrown off in the planes of the solar or planetary equators. Schiaparelli advanced the theory of their capture through the sun's attraction from the depths of space.

Proctor has demonstrated the inadequacy of these theories to explain meteoric phenomena, and has proposed their volcanic ejection from the planets.

Tschermak derived them in like manner from the interior of the earth, while Daubree found their origin in the stars. All these theories however, have been demonstrated indefensible, and Ball still insists that the origin of these bodies must be looked for within the special domain of the solar system.

The building up of the Sun and the planets from this meteoric dust, is also an idea, many times previously advanced. Sir J. Norman Lockyer in his "Meteoritic Hypothesis" has erected Suns, Planets, Comets and Stars from this material, but he borrowed his meteorites ready made, from the depths of outer space.

Proctor seems to have advanced this theory of world building as early as 1870 in his "Other Worlds than Ours."

Nordenskiöld suggested the growth of our world from a small beginning to its present domain through the fall of cosmic dust.

(Voyage of the Vega, p. 103.)

Lord Kelvin in 1887 stated that he believed the Sun "to be built up of stones" or "snow flakes of matter."

M. Faye has constructed our system theoretically, by assuming an original chaotic diffusion of meteorites through space, into which aggregation of matter, order and method are introduced by the aid of Descartes vortices.

Professor T. C. Chamberlin also seems to have accepted as an "almost certain truth"—"that the earth was built up of meteorites falling together."

(Science, June 30th, 1899.)

Many others have speculated to more or less extent in the same direction. *The theory of meteoric growth of planets herein advocated is therefore not new, but the suggested origin of the meteorites themselves, as being part and parcel of our own system, has, in so far as the writer can learn, not been previously offered.*

#### METEORITIC SHOWERS—COSMIC DUST.

As this condensation of celestial material at the surface of the nebula progresses, the precipitation towards the centre becomes a rain of cosmic dust, particle follows particle, until shortly the entire interior of the nebula—that is to say the entire solar system, becomes filled with these meteorites, falling in nearly right lines from the surface to the centre and reaching that centre from every conceivable direction. Here, aggregation must necessarily take place and this aggregation will soon result in a comparatively cool nucleus built up solid from the centre outwards, and fast increasing in size, under the effect of the ever continued down-pour of material.

With the growth of the nucleus however, the

velocity of the meteoric fall is increased—a greater force of impact due to the acceleration of speed from the increasing attraction of accumulated matter at the centre—produces increasingly greater manifestations of heat at the surface of the nucleus. The nucleus consequently will continually increase in temperature from the centre outwards, as the building up progresses.

That substance whose critical temperature was first reached will be followed, when the cooling has sufficiently progressed, by the element next in order, and this in turn by others, until lastly those elements which go to make up our atmosphere and our seas will be the last ones deposited upon the solid nucleus. These latter however, owing to the great accumulation of heat at the surface, remaining in gaseous form. The condition of this residual gas will be something as follows: Immense compression under the force of gravity (the assumed equilibrium being now broken by the great accumulation of matter at the centre) will produce a dense stratum near the surface of the nucleus.

This heat of compression, added to the heat derived from the friction of meteoric matter, in its passage through this dense stratum, will raise the temperature to incandescence, and this temperature will have been constantly on the increase with the growth of the nucleus. For an example of this ideal condition, let us point to the photosphere of our Sun.

The rise in temperature of the photosphere as above noted, is in accord with Lane's law.

Now as to the heat from friction heretofore alluded to. We can see that the impact of the rain of meteoric matter, which impact will reach its

maximum effect at the latest stages, will impart by friction to this dense surrounding envelope, an enormous quantity of heat, acting in this case like those meteorites, which, having given up to our air a large amount of heat through friction, are found later buried in the earth covered with ice. In fact, it is quite possible that this matter, while adding many heat units to the photosphere, may extract heat from the solid nucleus.

We have thus derived the Sun and its heat through our theory and will now consider

#### THE ELLIPTIC FORMS OF ORBITS.

The meteoric dust first precipitated from the surface, towards the centre of the nebula, we note will fall in orbits differing little from a straight line, but with the decreasing diameter and increasing surface velocity of the nebula, these orbits gradually pass through every value, until at later periods, when the surface velocity has acquired its maximum rate, they approximate closely to a circular form, and dust falling in these circular orbits will of course not reach the nucleus (the Sun) but owing to the similarity of their paths and to the slight differences in their orbital speed, will at some point, exterior to the Sun's surface, aggregate themselves together as planets.

We thus discover that orbits of all possible degrees of ellipticity, between a straight line and a circle, are necessary consequences of the theory.

#### THE FORMATION OF PLANETS.

The constantly increasing rotational movement of these descending materials (after crystallization, it becomes orbital motion) will finally, as time progresses, attain such magnitude as will pre-

vent the particles from reaching the Sun's surface. Here, then, will commence the building up of the first and oldest planet, Mercury. Venus, the Earth and Mars will follow in regular order.

But it would seem that owing to the progressive increase in area of the zones, a continual increase in size of planets should follow. This increase will appear until we reach Mars, where the law fails. And when we pass one step further outward—to the asteroids—the difficulty of size is a hundredfold multiplied. But let us reflect. During all this time the surface velocity of the nebulous mass has been increasing. It would seem that after the earth had been formed, this increasing speed of the outer nebulous surface may have reached that stage which made necessary the abandonment of rings, as called for by the old theory. If so, there was less material for Mars' construction, and her reduction in size is accounted for. Mars and Neptune, may, therefore, be of approximately equal age, with this difference,—Mars was left in a solid and cool condition, Neptune's material was left in the form of a great nebulous ring, and this ring may be now in some advanced stage of condensation, by the same system of meteoric precipitation.

This theory would thus fix the relative ages of the Sun and planets approximately as follows:—

First and oldest—The Sun.

2nd—Mercury.

3rd—Venus.

4th—Earth.

5th—Mars.

6th—Neptune.

7th—Uranus.

8th—Saturn.

9th and last formed—Jupiter.

with the asteroids, probably of all ages, between

those of Neptune and Jupiter, as will be hereafter shown.

Theoretically we have now constructed our earth as a body, solid from the centre outwards, moderately heated at the centre, but incandescent at the surface and surrounded with a gaseous envelope containing the united volumes of the atmosphere and the oceans. If we assume the average depth of the ocean (over the entire area of the earth) to be 10,000 feet, a figure not seriously in error, we find that the resulting pressure at the earth's surface, from the weight of this vaporous mass, would be approximately 4550 lbs. per square inch.

But this envelope contained matter other than the seas and the air, it contained a vast mass of vaporized material, derived from the combustion of the meteoric rain during untold ages. It contained some of all of the materials entering into the construction of the earth. It contained originally all that material now represented by our coal, limestone and salt beds, and it contained all the silica that has since been precipitated from the sea. In addition to this it contained a vastly greater quantity of water, than is contained in the present seas. No water could then exist in the earth's interior, but it has been penetrating from the surface downward since that moment when the progressive cooling first allowed the fall of rain on the earth's crust. Like the moon, which has in such manner lost all of its aqueous envelope, the earth has probably lost a large portion of its original seas.

Adding then, these lost and deposited parcels to the vapors at one time surrounding the globe, we find the pressure, given above as 4550 lbs. to the

square inch, increased to an unknown but immense extent.

#### THE ORIGIN OF GRANITE.

Passing now from speculation cosmological to speculation geological, we would suggest as follows:—

No matter whether we adopt Laplace's hypothesis, or the one herein contained, it follows, that owing to the primal heated condition of the earth's crust, all our seas must have been at some period of time, in the condition of gas as above suggested,—it is also necessary to assume even in Laplace's theory, that these hot gases under a pressure of many thousands of pounds to the square inch, in contact with the molten surface of the globe, should have dissolved and taken up vast quantities of earth building material. It is also certain that the gases surrounding Laplace's original earth, must also have absorbed much material from the meteoric rain, which we must suppose to have been at that time, greatly in excess of present meteoric precipitation. Under either hypothesis, we therefore have a tremendous store of Silica, Iron, Lime, Carbonic Acid, etc., to take care of during the subsequent cooling and precipitation of this gas upon the earth's surface, by which precipitation it assumed the form of our present seas.

It seems that this overloaded gas must certainly have once surrounded the earth—no matter what system of world growth we follow, it is equally certain that this gas could never have cooled down through perhaps thousands of degrees of temperature without yielding up to a great extent, its stores of minerals. It is easy therefore to find in this cooling process, an explanation of the deposit in semi-



stratified form of all our granite and gneiss, while the deposit of the so-called crystalline limestones and many of the schists, etc., we may relegate to a period still later, to a period in fact when the waters having been precipitated in entirety on the earth's surface, were still in a heated condition.

Mr. Sorby's demonstration that granite has been deposited under great pressure, finds ready explanation under this theory.

#### DIFFERENTIAL DRIFT OF THE SURFACES OF THE SUN AND JUPITER.

Professor Young, in his "General Astronomy" tells us that "No explanation of this strange equatorial acceleration has yet been found," but let us apply our theory. We then see that owing to the rotation of our nebula, any crystalized material falling from near its equator, under the law of gravity, will necessarily take a path in the form of a spiral, while similar matter sinking from polar regions will fall in straight lines to the nucleus, and this polar material will have no tendency to accelerate the rotation of the nucleus, but will rather retard the same through inertia.

We also see that this equatorial matter will have a constantly increasing angular and linear velocity, increasing in greater ratio as the accumulation of the nucleus progresses; and this constant acceleration, increasing as we approach the equator, must necessarily impart to the equatorial envelope the differential motion as observed.

We conclude from this that the solid nucleus will have a resulting angular motion compounded from the extreme forces at the equator and the nil forces at the poles. That is to say, the nucleus will revolve slower than the gaseous belt surrounding

the equator and faster than the gaseous surroundings of the poles, the velocity of the gaseous surface decreasing uniformly from the equator to the poles. And thus, the deductions from our theory are found in accord with the facts of observation.

It can be shown that owing to the polar flattening of the nebula, and the consequent preponderance of material over equatorial regions, the form of an oblate spheroid would be taken by the nucleus as perfectly as if formed from a rotating fluid mass.

#### THE ORIGIN OF COMETS.

In undertaking the explanation of the origin of comets, it seems that we are entering upon a virgin field, we are invading territory wherein no one has preceded us. Swift says: "Cometary Astronomy \* \* \* is the most mysterious and the darkest part of the science of the heavenly bodies." These apparitions are absolutely parentless. The great theorists have expressly disowned them. They are looked upon as wandering tramps without home and without country, and they have intruded themselves into our society unbidden. But are the views above expressed necessarily correct? It should follow that any theory offered as to the origin of our solar system should supply a cosmogony for the entire contents of that system. Our almost infinite distance from any other system forbids the idea that we have stolen from our neighbors the 17,500,000 comets of Arago or the 500,000,000 comets of Lambert, and have ourselves escaped without loss. We will therefore proceed in the application of this hypothesis.

We will assume that the original nebula has become reduced, under the system of condensation

and precipitation suggested, until its outer surface has approached the nucleus (the Sun) until it extends, perhaps to the orbit of Neptune. We will take a circular area on this surface, due to a diameter of say 10,000,000 miles, and will consider the precipitation towards the centre from this area. We first note that the rotational velocity of the nebula resulting from its decrease in size, has so changed the paths of the crystals there condensed, that they no longer reach the Sun, but pass near to it, in orbits whose periods are approximately one-half of that of Neptune.

We see then that the forms of all of these orbits will be identical, that the velocity of fall in all cases will be the same, and that a continual stream, one meteor following another in identical orbits, will be the consequence of progressive crystallization.

But these meteors when at the distance of Neptune occupied an area due to a diameter of 10,000,000 miles; as they approach the earth's orbit on their converging journey, towards perihelion they have passed over 29-30ths of their distance from the Sun, while the area across the swarm has been reduced *nine hundred* times by the convergence of what we might call the orbital cone. The approach of the members of this swarm continues, collisions become frequent, friction of colliding particles generates heat, electrical conditions supervene from the same cause, and finally the resulting incandescence makes visible a comet. A blank space in the heavens today may be filled by a gigantic comet tomorrow. It has not been seen to approach, it was born a moment before in mid-heavens.

We see that the birth of the comet, while approaching perihelion, is due simply to the converg-

ence of the meteoric paths. After passing perihelion it can be seen that each individual meteor must pass entirely through the balance of the swarm and we therefore might suppose the impacts and collisions after passing perihelion might exceed in number those of the approach and we might expect therefore some evidence of this increased number of impacts in the changed appearance of the comet or of its tail immediately after its recession from the sun had commenced.

Now that we have formulated the new theory of comets, let us proceed to its analysis, that we may judge as to its merits:

#### COMETARY LAWS.

1st. Our theory tells us that if comets enter upon their collision period when in proximity to the earth, their appearance should be sudden and unexpected.

2nd. We should expect that when first seen, these comets owing to their distance from perihelion toward which the meteors converge, should be large in size but faint in illumination.

3rd. As they approach the sun, they should decrease in size, with the convergence of the orbital cone.

4th. They should increase in brightness as they approach the sun, with the increased number of impacts due to convergence.

5th. Variation in their spectra should occur with variation of mechanical effort due to an increased number of impacts.

6th. The comet should shine with its own light as the result of these impacts.

7th. The minimum of size and the maximum of light should take place about the time of passing perihelion.

8th to 11th. The exact converse of Nos. 5, 4, 3 and 2.

12th. As the comet disappears while yet near the earth, having reached the region of no collisions, that disappearance should be abrupt and sudden while still in "full sight."

13th. As all these collisions must tend to produce parallelism in the orbits of the individual members of the swarm, the intensity of the action in long periods should continually diminish, and likewise the magnitude and brilliancy of the comet.

14th. Comets, which at their first appearance, are large in size, necessarily belong to meteor swarms whose combined orbits form a cone of rapid convergence, a near approach to their meet-

ing place; the Sun, is therefore required for the production of the comet.

Small comets, belonging to cones of less convergence, enter upon this collision period at greater distances from the sun. These latter therefore should become first visible, notwithstanding their small size.

15th. Owing to the increased number of impacts, due to intersection of orbits, the tail should increase in size after passing perihelion.

Here we have 15 Rules, so to speak, for the explanation of cometary development, and this code is perhaps the first attempt that has been made to control the action of these bodies by law. Let us now examine as to how the observed facts relating to comets, compare with the deductions from our theory.

Professor Young says:—

"It is a very singular fact that the head of a comet continually and regularly changes its diameter as it approaches to and recedes from the sun; and what is more singular yet, it contracts when it approaches the sun, instead of expanding as one would naturally expect it to do under the action of solar heat."

(Young's *Italics*, General Astronomy, p. 405.)

"When this body (Encke's comet) first comes into sight\*\*\*\*\* it has a diameter of nearly 300,000 miles. When it is near perihelion \*\*\*\*\* its diameter shrinks to 12,000 or 14,000 miles." (Page 406.)

"As it (Encke's comet) recedes, it expands and resumes its original dimensions." (Page 406.)

"It is maintained by Mr. Lockyer that the spectrum of a comet changes as it varies its distance from the sun." (Page 410.)

"They become less brilliant as they recede from the sun and finally disappear while they are in full sight, simply on account of faintness and not by becoming too small to be seen." (Page 408.)

"As the comet draws near the sun, it brightens." (Page 411.)

"They are certainly self-luminous, their light being developed in a way not yet satisfactorily explained." (Page 403.)

In the "Meteoritic Hypothesis" Mr. Lockyer says:—

"We know that the short period comets get less brilliant with every approach to perihelion." (Page 169.)

"Large comets should begin to be visible long before smaller or more distant ones, but this does not appear to be so." (Page 230.)

"As a rule the tail increases very quickly and considerably in length, after perihelion passage." (Page 235.)

We see from these citations that every one of the fifteen laws which we have derived theoretically from our hypothesis, are supported by the facts of observation. How then are we to explain this extraordinary co-incidence between theory and fact? We cannot invoke accident or chance in this matter. To thus reduce the heretofore, supernatural, unexplainable phenomena of comets to law, it would seem that we must suppose our hypothesis to contain a close approximation to the real origin of these bodies.

There remain two peculiarities of comets yet to be considered, one, the retrograde motion of many of these bodies, the other the apparent connection existing between certain planets and what we might call their cometary appendices; but we still have the outlying nebulous wisps or streamers of our irregularly shaped nebula to care for. These detached patches of gaseous matter, with rotation periods perhaps differing from that of our main nebula, kept at arms length by the expansive force of their contained gases, can never hope to approach the Sun, until after their condensation into the solid form. Streams of meteoric matter, thus formed from these outlying masses, may speed towards the Sun from any and all directions, their motions may consequently be direct or retrograde, and furthermore these streams from the remotest portions of the Solar System, will certainly, to some extent, be captured by the greater planets and thus provide origin for the family arrangement mentioned.

If there be reason in this theory, planets external to Neptune should be looked for in explanation of remote cometary groups, as suggested by Professor Forbes, who has already demanded two such bodies.

When we consider the endless number of these meteoric streams, their frequent intersections in space, the retardation possibly of one part of a stream and acceleration of another, we can understand the division of a comet into two; their sudden increase in brilliancy while receding in space, the families of comets following in the same path, and in short, all cometary phenomena seem due to natural causes, unless we except their tails. As to these latter, we may speculate as follows: If the zodiacal light, which extends far beyond the earth's orbit, be a "residuum of the nebulous fluid of our system" immensely attenuated, then we might imagine these tails to be merely electrical phenomena with the nebulous fluid as conductor and our mechanically excited comet as generator; we would also imagine the electricity generated to be of the same sign as that produced by the sun when the tails pointed from the sun, and vice versa.

If these tails are merely electric excitations of this attenuated nebulous fluid, they are therefore imponderable, and we will no longer wonder that a comet may whisk around the sun through an angle of 180 degrees in three hours and its tail escape being snapped off into the hereafter!

To make clear the fact that the intimate relation between comets and meteors demanded by our theory, has actual existence we will quote again from Young's Astronomy:

"And now we come to one of the most remarkable discoveries

of modern astronomy—the discovery of the connection between comets and meteors.” (Page 443.)

“Schiaparelli of Milan \*\*\*\*\* brought out the remarkable fact that they (the Perseids or August Meteors) were moving in the same path as that of the bright comet of 1862, known as Tuttle’s comet.” (Page 445.)

“Oppolzer’s orbit of Temple’s comet of 1866 is shown on page 445 to be practically identical with Leverrier’s orbit of the Leonid meteors.

(All the italics in these quotations are Young’s.)

“However these things may be, it is now certain that the connection between comets and meteors is very close.” (Page 446.)

This close connection has led to the almost general belief that meteor swarms are “merely the product of a comet’s disintegration” but it seems that under the logic of our hypothesis we must invert this statement, making the comet a *product of the meteor swarm*, and the truth of this law seems indisputable.

The universal distribution through the solar system of this meteoric dust, would seem to confirm to some extent our theory of its origin. It is not easy to understand how, if these swarms were captured by planetary attraction, from interstellar space—the distribution could be so uniformly placed as to allow the precipitation of 400,000,000 of these bodies to the earth’s surface in every 24 hours.

#### COMETARY ORBITS.

The cometary orbits tell us that space at all distances from the ecliptic is likewise traversed by these streams, only unlike the zodiac, which has been largely swept of meteoric dust by the circulation of the planets, their numbers there are probably much greater than with us. This rain of solid matter falling towards the Sun from every direction, but reaching that body only in part, is impossible to explain under the capture theory, while



under the theory of a precipitation from the surface to the centre of a nebula, their incalculable numbers,—their converging orbits—their distribution in space—all appear clear to the understanding.

The hyperbolic orbits educed for some of these bodies, are, however, a strong argument against our theory. But let us examine this objection. Young says:

("General Astronomy, page 398), speaking of 270 comets,

"The orbits of six "appear to be hyperbolic, although the eccentricity exceeds unity by so small a quantity as to leave the matter somewhat doubtful."

Newcomb says, Popular Astronomy (4th Ed., p. 379):

"It cannot therefore, be said with certainty that any known comet revolves in a hyperbolic orbit, and thus it is possible that all comets belong to our system."

This argument then fails through uncertainty. Our theory would indicate that as information becomes more exact from future data, all these so-called "hyperbolic" orbits will be found safely within the parabolic limit.

In conclusion it would appear that we are no longer compelled to regard comets as strangers from interstellar space. We should no longer picture them as plunging into the celestial deep for an excursion of ages. The life of a comet as compared with the orbital period of its mother swarm is but a moment; and when our spectre disappears from view, it has not only passed out of sight, but it has passed out of existence. It has resumed its normal condition of a migratory sand bank.

#### THE VISIBILITY OF NEBULAE.

The preceding discussion enables us to understand why nebulae too rare and attenuated to retain

heat sufficient for incandescence, may yet be visible at incredible distances in the heavens.

Heretofore we have studied but a small portion of the surface of the original nebula, deriving from this small portion our theory of comets. We will now consider the entire surface of the nebula as precipitating towards the centre its downpour of meteoric dust. Instead of an isolated comet then, lit up by the impact of these converging bodies, we find the entire interior of our nebula, inside of the collision distance, illuminated by the electrical and mechanical results we have contrived. In other words a comet represents a mere fraction of this meteoric precipitation. A nebula represents the united whole, and the comets, the nebula,—the zodiacal light, and the Aurora Borealis, may be simply different degrees, or different conditions of the same phenomena.

#### BINARY SYSTEMS AND NEW STARS.

If we suppose the original nebula to have had no movement of rotation on its axis—meteorites formed at its surface would fall in right lines to the center and there would be no rotation of the nucleus. This latter would in that case, form a single star, or sun, with no possibility of planets in connection therewith.

With an original slight rotation, a system including both Sun and planets would result; as already shown, while with a great amount of original rotation, no matter could reach the center, but aggregation would commence in the form of a great annular mass, which at some later period would necessarily break up into several centers of local accumulation—thus forming binary or higher systems as might fit the conditions of each case.

The mystery in which the new stars are involved, would likewise disappear in the light of this theory. The abruptness of the appearance of these bodies—the sudden generation of their light and heat, and the comparatively rapid manner in which they decrease, have been the cause of much discussion.

If these were real suns, so born, apparently in a moment, we should expect them to continue as permanent objects in the heavens. But under the requirements of our theory—that these effects are due to a meeting between some planet, or star, and a great cloud of meteors, the suddenness of their appearance offers no difficulty, and again, as we know the effects of impact would be confined to the very surface of the body encountered—the comparatively rapid decrease in brilliancy which has been observed could have been readily foretold.

#### THE VARYING DENSITY OF PLANETS.

No solution of the problem of variation in planetary densities has ever been discovered under the doctrine of Laplace.

With the present theory however, there appears a logical explanation. We have already seen that the crystalization of meteorites is probably controlled by conditions of temperature in the nebula. But these conditions are continually changing, our gaseous mass is ever increasing in temperature.

The resulting meteorites are therefore ever varying their specific gravity, and it would be impossible to expect other than variety of density in the resulting planets.

#### OBJECTIONS TO THIS HYPOTHESIS.

In attempting to analyze the scheme of world building now outlined we encounter certain grave

objections. It would seem however, that these objections are neither so numerous nor so formidable in their nature, as those that now confront the theory of Laplace.

One of the most serious difficulties, in view of the customary idea of placing the original limit of our nebula at some point slightly external to Neptune, is the tremendous distance beyond the orbit of this planet to which we must extend our primordial nebula in order that we may explain the long period comets, some of which perform their cycles with duration of thousands of years.

This objection may however, be less important than at first appears. Under the undulatory theory of light, it is a necessity that we assume matter in some form to exist through all interstellar space, that light vibrations from the most distant stars may be enabled to reach us.

Now if we could imagine our Solar System, for instance, to be but a local accumulation of this universally distributed material (and no one can positively say that this is not the case) it would then be easy to picture the outer limits of our fluid as extending at one time even half way to the nearest fixed star, or to such other distance as would enable us to account for periods of any conceivable length in comets.

The alleged hyperbolic orbits for certain comets can not, in our present state of knowledge be considered as offering serious opposition to our theory. It being highly probable, as has already been shown, that such orbits have no real existence.

The suggested derivation of the retrograde motions for some of the long period comets, is also very unsatisfactory, and seems to involve a physical absurdity. The idea is a mere makeshift, and the fact

remains that these retrograde motions offer serious objection to our system.

Other objections occur. The premised crystallization of our meteorites, from the primordial fluid, can not be classed as a known process. The division of the planets into two groups, with point of separation between Jupiter and Mars, and the building up of these groups under different methods also seems defective. This manner of construction could be avoided however, by obtaining all the planets from the original precipitation toward the centre, although this plan would leave Jupiter's greater mass apparently unexplained. The partially retrograde motions in the satellites of Uranus and Neptune are also unaccounted for under our theory, unless we can suppose these moons to have been due to late captures of meteoric dust, or that their lawless action may be due to the irregularity in form of the original nebula.

This irregularity in form it would also seem necessary to invoke, in explanation of the varying inclinations of the orbits of the planets to the Sun's equator. This solution would answer as well however, for the theory of Laplace.

#### CONCLUSION.

Notwithstanding the objections above mentioned, the fact remains that our hypothesis has satisfied observed conditions far more completely than has any of its predecessors.

It explains much where previous theories have failed.

In the matter of comets, which have especially eluded the grasp of all theorists, it would necessarily seem that we have made a distinct advance. The extraordinary manner in which the new hypothesis